

Standing up, leaning on the jamb of the door at the front of the house, biology teacher Vitorino Coelho de Sousa listened, without paying much attention, to a garrulous lad who was enumerating for him the teachings of the Bible, in the hope of converting him to the evangelic religion. Suddenly, the calm conversation – one of so many that still take up the late afternoons in small towns – took unexpected turns, gave rise to a story rich in apparent flukes, and resulted, days afterwards, in the finding of roughly 70 dinosaur fossils some 110 million years old, found in the hinterland of the state of Maranhão, and in the discovery of a possible new species of these giant prehistoric reptiles, eliminated from the planet 65 million years ago. Up until then, samples of dinosaurs so old were rare in the Northeast.

We are in Coroatá, a town with 50,000 inhabitants, in the interior of Maranhão, 200 kilometers to the south of the capital, São Luís, on an afternoon at the end of July last year. After listening to the visitor for a good many minutes, Vitorino lost his patience and went into a clash between science and religion, with heated arguments on both sides, while the young evangelist claimed that the animals existing in the world were of divine origin. Being a biology teacher at a secondary school, Vitorino decided to teach the lad a bit of science. He explained that petrified remains of plants and animals, fossils, were a proof that present-day living beings were not a work of God, but they had evolved from other species that arose millions of years before. Amazed by the explanation, the youngster commented: “A short time ago, I saw some stones that looked like bone, right here in Coroatá, in someone’s house”.

Vitorino spent days intrigued with this comment. At the end of the week, he decided to check it out. He picked up his camera, went on to the region indicated, and arrived at the homestead of farmer Alexandre Marques Vaz, a planter of cassava, potato, rice and corn, who had indeed collected, over 13 years, some stones that were similar to bones. The shape of these stones had already generated long debates between Alexandre and his neighbors. Some thought they really were bones of an animal – perhaps even of an elephant, by their size, and why not? –, while for others all that was no more than ordinary stones.

Vitorino had to spend a lot of conversation to convince the suspicious farmer to show him the said stones, guarded with the zeal of someone hiding a treasure. And there were not just a few of them: they lined the floor of one of the rooms of the brick-built house, without any plaster, where the 32-year-old farmer lives with his wife and children. Alexandre had collected the stones from the banks of the tributaries of the Itapecuru river, which cuts through Coroatá and runs in a north-



PALEONTOLOGY

Under the palm trees



PHOTOGRAPH BY MIGUEL BOYAXAN

westerly direction. From July to November, when it rains little, the bed of the river drops and the terrain dug out by the water becomes exposed, after having been covered by the forest of babassu palms – this is palm tree woodland, vegetation typical of this region of the Northeast, which spreads to the east through Piauí and Ceará, occupying an area that is larger than England.

The vertebra and the phone book - Under the shrewd gaze of the owner of the house, Vitorino straight away cast his eye on a cylindrical petrified bone, of almost 20 centimeters in diameter. Remembering his lessons in paleontology from his undergraduate course at the Federal University of Piauí (UFPI), he immediately came to a conclusion: it was not an elephant bone, as they had imagined, but a petrified vertebra from the tail of a dinosaur.

As the dinosaur fossils found in the country are rare, Vitorino knew he was facing some material of great scientific interest. For this reason, he decided to make the discovery public and called a team from TV Mirante, which retransmits the Globo TV network in Maranhão, to do a story. But he did not like the program, which went on the air a few days afterwards, just in the Coroatá region. “It was sensationalist”, was his definition. Dissatisfied, Vitorino picked up the telephone directory in search of a specialist, and arrived at paleontologist Manuel Alfredo Medeiros, from the Federal University of Maranhão (UFMA). “I thought it was one more false alarm”, Medeiros recalls. “Two other times, they had called me to see fossils in other towns, but they were recent bones.”

But as the region could in fact house dinosaur fossils, Medeiros took a chance. He went to Coroatá and was not disappointed: the fossils were indeed of dinosaurs. The major part of the petrified bones are from sauropods, herbivorous dinosaurs with a long neck and tail – the largest sauropods, found in Argentina, reached 30 meters in length and weighed as much as 70 tons. The part with the greatest scientific value is precisely the vertebra from the tail seen by Vitorino at the first encounter with the farmer. According to Medeiros, the fossil belongs to a new species of sauropod, which must have inhabited this region between 110 million and 100 million years ago, during the geological period called the Cretaceous. It was an indirect dating, done on the basis of geological studies by Petrobras and the Federal University of Rio de Janeiro (UFRJ).

The discovery also confirms that this region of Maranhão is an immense deposit of continental fossils from a phase of the Cretaceous period that runs from 110 million to 95 million years ago. According to Medeiros, the findings are rare because the layers of more superficial rocks that contain fossils are to be found at a depth that ran-

A biology teacher and a farmer
take part in the discovery
of a vast deposit of dinosaur fossils
in the interior of Maranhão

RICARDO ZORZETTO

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Treasures from Coroatá



110 million year old fossils found when the tributaries of the Itapecuru dried up

PHOTOGRAPH BY MANUEL ALFREDO MEDEIROS/UFMA

ges between 5 and 15 meters under the Cerrado (savanna) and the palm tree woodland. “If a new dating confirms the age of the fossils at between 110 million and 100 million years, this material should provide precious information about the continental fauna of this phase of the Cretaceous”, says Medeiros. In those days, South America and Africa were still right in the process of separation, and the landscape of Ma-

ranhão was very different from the present. Research by UFRJ and Petrobras has showed that the climate was predominantly arid or semi-arid, but in the regions close to the rivers, there were forests of conifers similar to araucarias, bracken the size of trees, and plants called equisetia, which look like horsetails.

As the conversation went on, Medeiros convinced farmer Alexandre Marques Vaz to make him a donation

at least of the sauropod vertebra, kept today at the UFMA’s Paleontology Laboratory. Now, starting from this bone, the researcher intends to identify the animal to which it belonged – before going any further, it does seem something really new, from a genus and species still unknown to science. “We want to know if these groups lived in Africa as well, or if they are exclusive to Brazil”, says the paleontologist. It is now up

The new dinosaur from Maranhão

In January, the team led by geologist Ismar de Souza Carvalho, from the Federal University of Rio de Janeiro (UFRJ), presented the reconstitution of a new species of Brazilian dinosaur, which lived in Maranhão 110 million years ago. It is the *Amazonsaurus maranhensis*, a herbivorous quadruped of 10 meters in length from head to tail and weighing some 10 tons. It was described in the December 2003 issue of *Cretaceous Research*, the most important scientific magazine about the Cretaceous, the last geologic period in which these large reptiles inhabited the planet.

The *Amazonsaurus* is the oldest Brazilian sauropod (a herbivorous quadruped dinosaur) from the Cretaceous, a geologic period that ran from 144 million to 65 million years ago, in which plants with flowers emerged and South America began to separate itself from

Africa. The team from UFRJ found fossils from this dinosaur on the banks of the Itapecuru river – in the municipality of Itapecuru-Mirim, 130 kilometers to the south of the capital, São Luís –, an area of transition between the Amazon Forest and the Cerrado, still within the legal Amazon. For this reason, this animal is regarded as the first dinosaur from the Amazon whose species has been identified.

Marked characteristics of this species are the neck and tail that are longer and more tapered at the ends than those of the other sauropods. On the back of the *A. maranhensis*, a small elevation is prominent: they are prolongations of the vertebrae of the backbone, known as neural spines, that stand out as much as 20 centimeters. According to Carvalho, the new species is a distant relative of a sauropod that lived in the northwestern

region of Africa in this same period, the *Rebbachisaurus garasbae*. The vertebrae of both of them are very similar – a sign that they must have evolved from one and the same ancestral species.

The discovery of the *Amazonsaurus* will make a contribution towards an understanding of how Brazilian terrestrial environments evolved in the Cretaceous, much less studied than the marine environment in this same period, when the Brazilian reserves of oil and gas, located in the Atlantic, were formed. “From now onwards, the analysis of the evolution of the sauropods will have to include a study of the *Amazonsaurus maranhensis*”, Carvalho explains.

The announcement of this discovery crowned 13 years of work marked by hitches. Under the coordination of the veteran chemist Cândido Simões Ferreira, today at the age of 84 an eme-

to Darciléa Castro, from Medeiros' team, in conjunction with paleontologists from São Paulo, to begin to classify the other 70 or so petrified bones. By dint of many scientific arguments, the reticent Alexandre abdicated his collection, which, it has now been agreed, will remain under the custody of the Coroatá House of Culture.

The basin of the Itapecuru, which describes an arch from south to north in Maranhão, is regarded today as a veritable dinosaur valley. It was from there that came the fossils of the most recent Brazilian species of dinosaur: the *Amazonsaurus maranhensis*, described by the team of geologist Ismar de Souza Carvalho, from UFRJ (see box). In 2001, the teams of Medeiros and Carvalho found on Ca-

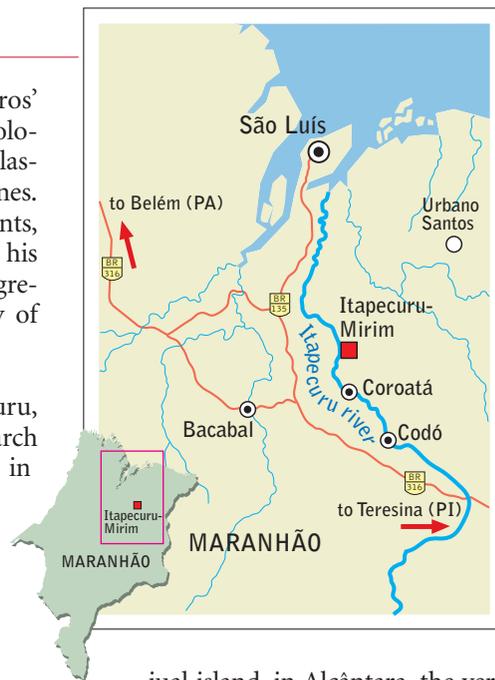


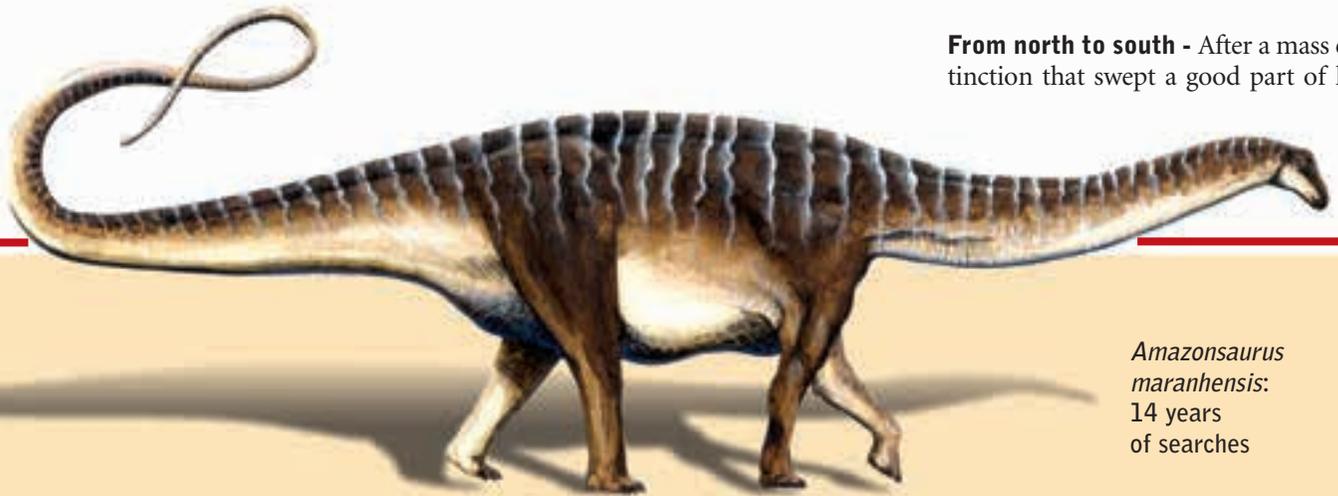
ILLUSTRATION BY SIRIO J. B. CANÇADO

jual island, in Alcântara, the vertebra of a new species of sauropod, those corpulent herbivorous dinosaurs with a long neck and tail and a small

head. With an age of about 95 million years, this petrified bone belonged to a sauropod from a group of saltasauruses. Previously found only in Argentina, the saltasauruses used to measure about 8 meters from head to tail – they are the dwarfs of the family of the titanosaurs, animals that could reach to 30 meters and almost 70 tons.

The discovery of the fossil from Caju island, almost 20 million years older than the Argentinean saltasauruses, made it possible for the Brazilian paleontologists to present a new version for the evolution of these animals. “They probably arose in the region where the north of Brazil is today, and then migrated south”, Medeiros says. The researchers from Rio and from Maranhão have now determined the genus and the species of the saltasaurus from Maranhão, but its name will only be revealed in a few months from now, with the publication of the scientific article that describes it.

From north to south - After a mass extinction that swept a good part of life



Amazonsaurus maranhensis:
14 years
of searches

ILLUSTRATION BY ARIEL

ritus professor at UFRJ, in 1991 five young researchers did their first trip to the hinterland of Maranhão to map the areas where there are outcrops of rocks formed in the Cretaceous, to serve as training for the geology students at UFRJ. Regarded as being of great economic interest for holding about half of the planet's reserves of oil and gas, these areas of rocks from the Cretaceous add up to 150,000 square kilometers – or 1.5 times the size of Portugal – in Maranhão alone.

Accommodated as best as possible in a Kombi van laden with provisions, the six researchers set off from Rio and crossed half the country in a five-day

journey. In three weeks of intense work, the team covered hundreds of kilometers analyzing plots of land close to railroads and highways without locating a single area with the rocks they were looking for. Tense and tired, the researchers decided to change their strategy and began to cover the rivers of the region by boat, and then they arrived in the municipality of Itapecuru-Mirim – 70 kilometers away from Coroatá, where more dinosaur fossils were recently found.

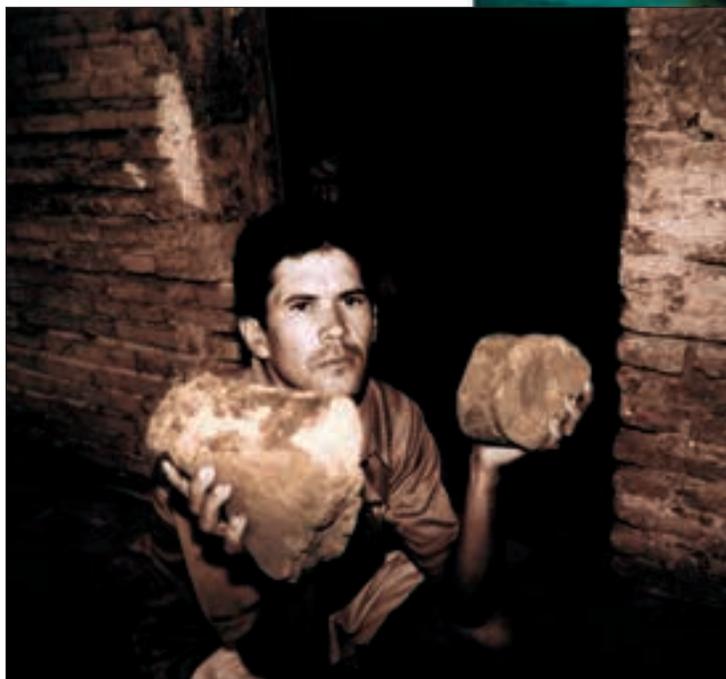
In one of the first stops on the banks of the Itapecuru river, getting off the boat, Ferreira tripped on a large object, mistaken at first for a bone from a cow. This was the first part of the ske-

leton of the *Amazonsaurus maranhensis*, reconstituted from 20 well preserved pieces and another 150 bits gathered in the course of six years of excavations on the banks of the Itapecuru river. Just as difficult as extracting the fossils from the hard rock was to get recognition for the work, which Carvalho signs with Leonardo dos Santos Ávila, from the National Museum, and Leonardo Salgado, from the National University of Comahue, in Argentina. For dealing with an animal of an unknown genus and species, the article underwent many revisions in the course of three years, before being accepted by *Cretaceous Research*.

off the Earth 210 million years ago, the dinosaurs evolved from a carnivorous biped that measured less than a meter, the thecodont. Fossils found in different regions of the planet indicate that dinosaurs were the most abundant terrestrial animals during 150 million years, in a phase when the global climate was warmer and the continents of the Southern Hemisphere were still united in a supercontinent, Gondwana.



PHOTOGRAPH BY JEFFERSON ALBINO



Paleontologists believe that several species of dinosaurs used to inhabit what is today Brazilian territory, but the fossils of these animals are rare in these parts, mainly because the great reserves of petrified bones are covered by the palm tree woodland in Maranhão or by the Cerrado (savanna), in Mato Grosso and in São Paulo.

The Araripe fossils - Even though they are few, the fossils of Brazilian dinosaurs reveal valuable physical characteristics of these reptiles and are helping to understand how they evolved. Not very far from Maranhão there is one of the most important deposits in the world from a phase of the Cretaceous that runs from 140 million to 100 million years ago. It is the Chapada do Araripe, a table mountain 160 kilometers long by 50 wide that rises to a height of 900 meters in the south of Ceará and

spreads, to the east, to Pernambuco and, to the west, to Piauí.

In mining for limestone and gypsum in this region, fossils were found of another three species of dinosaurs. Two of them are part of the group of spinosauruses, biped reptiles of up to 10 meters in length, from whose back a sort of crest stands up. One of these spinosauruses is the *Angaturama limae*, described in 1999 by paleontologist Alexander Kellner, from UFRJ's National Museum, based on the fossils from the animal's

snout. A relative of the species found in Africa and Europe, this dinosaur lived some 110 million years ago. It had an elongated head and snout, and teeth like those of a present-day crocodile. In 1996, David Martill, from the University of Portsmouth, in the United Kingdom, using the hind portion of a skull found in the Chapada do Araripe and smuggled to Europe, identified another species of spinosaurus: the *Irritator challengeri*.

The *Irritator* won this name because of the anger its identification sparked

Reconstituted past:
Alexandre Vaz with fossils
of animals that 110
million years ago lived
close to rivers



ILLUSTRATION BY ANDERSON PINHEIRO

nes de Almeida Campos, from the National Mineral Production Department, in Rio de Janeiro.

In 1971, the team led by Farid Arid, from the São Paulo State University (Unesp) found in the region of São José do Rio Preto one of the two species of titanosaurs identified in São Paulo. There were only three petrified bones from the *Antarctosaurus brasiliensis*, an animal about which there is very little information. In the mid 80s, a farmer from Presidente Prudente, in the west of São Paulo, found fossils of another titanosaurus, which Kellner, in 1999, called *Gondwanatitan faustoi* – one of the most complete dinosaur skeletons found in the country. In spite of its 8 or so meters, the *Gondwanatitan*, which lived between 90 million and 80 million years ago, had a shorter neck and tail than the *Amazonsaurus*.

The oldest - But the cradle of the Brazilian dinosaurs is in fact in the environs of the municipality of Santa Maria, in the central region of Rio Grande do Sul. The three oldest species of the country – and probably of the world – inhabited the lands of Rio Grande do Sul 225 million years ago, during the Triassic. The oldest of them, proved to have been the first Brazilian dinosaur, is the *Staurikosaurus pricei*. Discovered in 1937, this carnivore of about 2.5 meters is one of the oldest dinosaurs of which one has notice.

Dozens of thousands of years more recent than the *Staurikosaurus* is the *Saturnalia tupiniquim*, a herbivore of no more than 4 meters in length, described five years ago by Max Langer, nowadays at USP in Ribeirão Preto. A curious characteristic of this reptile, an ancestor of such animals as the *Amazonsaurus* and the *Gondwanatitan*, is that, although it was a quadruped, it was capable of getting about on its hind legs alone in some situations.

In the municipality of Candelária, on the banks of the Guaíba river, fossils were discovered of a very primitive dinosaur with 1.2 meters. This was the *Guaibasaurus candelaria*, about 1 million years more recent than the *Staurikosaurus*. Initially classified as a carnivore, it is currently believed that this quadruped that could probably walk with just its hind legs was, in actual fact, a herbivore. •

off. Martill noticed that the back part of the skull belonged to a dinosaur, but the snout was not compatible with the description of any known group. It was only later that he discovered that the animal's snout had been artificially reconstructed by the smugglers in order to boost the fossil's sale price.

One of the most precious fossils is the *Santanaraptor placidus*, which also came from the town of Santana do Cariri, in the Chapada do Araripe. It is the first fossil of a dinosaur that, besides the bones, preserved part of the animal's hide, muscles and blood vessels. Measuring only 1.8 meters, this carnivorous animal that lived 110 million years ago is an ancestor of the well-known and feared *Tyrannosaurus rex*, an enormous

predator that dominated North America about 40 million years later.

Perhaps as ferocious as the *Tyrannosaurus* was the *Pycnonemosaurus nevesi*, the largest Brazilian predator. A biped reptile, 8 meters long, it lived 80 million years ago in the interior of Mato Grosso. With its short front members and well-developed tail muscles, the *P. nevesi* is similar to other animals from the same group found in India, Africa and Argentina. But the closest forms of the *Pycnonemosaurus* are in Argentina. "There must have been a fauna common to Argentina and Brazil, now different from that found in Africa", says Kellner, who described this large predator in 2002, in the Archives of the National Museum, in partnership with paleontologist Dióge-